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THE SECOND NATIONAL CHINESE CONFERENCE ON PERMAFROST, LANZHOU, --ETC (11)
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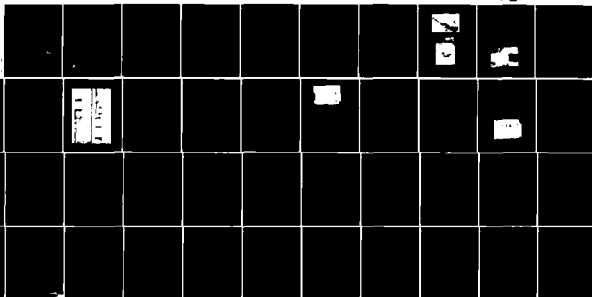
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The Second National Chinese Conference on Penetration

Langzhou, China, 72 - 18 October 1951

Jung Chang and Yin Chao Yen

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20. Abstract (cont'd)

✓ frozen ground research in China were represented. It was planned to present selected papers from this conference at the Fourth International Conference on Permafrost in Fairbanks, Alaska, in 1983.

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PREFACE

This report was prepared by Dr. Jerry Brown, Chief, Earth Sciences Branch, Research Division, and Dr. Yin-Chao Yen, Geotechnical Research Branch, Experimental Engineering Division, U.S. Army Cold Regions Research and Engineering Laboratory. Funding was provided by CRREL for Dr. Yen and partial travel funding was provided by the Polar Research Board of the National Academy of Sciences for Dr. Brown.

Additional support came from DA Project 4A161102AT24, Research in Snow, Ice and Frozen Ground, Scientific Area B, Cold Regions Environmental Interactions, Work Unit 002, Cold Regions Environmental Factors, and Scientific Area A, Properties of Cold Regions Materials, Work Unit 005, Thermophysics and Mechanics of Cold Regions Materials.

The authors thank Chen Goudong, Vice Head of the Permafrost Division, Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica, for reviewing this report, and Andrea Ploss, a student at Dartmouth College, for her help with the Chinese translations.

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THE SECOND NATIONAL CHINESE CONFERENCE ON PERMAFROST,
LANZHOU, CHINA, 12-18 OCTOBER 1981

by

Jerry Brown and Yin-Chao Yen

INTRODUCTION

The Second National Conference on Permafrost was held in Lanzhou, China, during 12-18 October 1981. It was attended by approximately 200 scientists and engineers from 69 organizations within China. The purpose of the meeting was two-fold: 1) to present and discuss results of frozen ground investigations that had been conducted since the first conference in 1978, and 2) to organize the Chinese contributions for the Fourth International Conference on Permafrost to be held in Fairbanks, Alaska, in July 1983. Several non-Chinese were invited. The authors from the U.S. Army Cold Regions Research and Engineering Laboratory, and Dr. Daisuke Kuroiwa (former Director, Low Temperature Institute, Hokkaido University) from Japan attended.

The purpose of this report is to make information available about the conference and some of the Chinese organizations involved in frozen ground research. In this report, frozen ground will be used to refer to both seasonally frozen soils and permafrost, since the conference dealt with both. In China the term cryopedology is used interchangeably with the "study of permafrost and seasonally frozen soil." Approximately 22% of China is underlain by permafrost and upwards of 73% has seasonally frozen soils.

Chinese research and engineering concerning frozen ground was initially brought to our attention when a Chinese group visited Canada in 1975 and a Canadian delegation visited China in summer 1977 under a scientific exchange agreement between those two countries. The Canadians visited North-east China (formerly Manchuria) by rail and described some of the permafrost conditions and problems. They also briefly visited the Lanzhou

Institute of Glaciology and Cryopedology, one of the organizing institutions for this Second Conference. Nine Chinese attended the Third International Conference on Permafrost in July 1978 in Edmonton, Canada. This provided the first major contact between U.S. and Chinese permafrost scientists and engineers. A U.S. delegation visited Harbin in 1978 as part of the U.S. Science and Technology agreement. Dr. Y.C. Yen was on that exchange and visited the Institute of Low Temperature Construction. Dr. Troy L. Péwé, a geologist and permafrost specialist, Arizona State University, visited China in May and June 1980 to attend the Symposium on the Qinghai-Xizang (Tibet) Plateau, and he has prepared and published several reports on his trip*.

LANZHOU

The conference was held in Lanzhou, China (see Fig. 1). Lanzhou is an industrialized city with a population of over 1,000,000. It is situated on the terraces of the Yellow River. Some 50 km or so to the west is the Liujiaxia Hydroelectric Power Station on the Yellow River (Fig. 2 and 3). This dam is the highest in China, with a height of 148 m, and is 880 m wide at the top. The power plant has a 1,200,000-kilowatt capacity. The dam is in the process of being raised 3-5 m as a result of the summer 1981 flooding along the Yellow River.

A major branch or bureau of the Academia Sinica (The China Academy of Sciences) is located in Lanzhou. It consists of six institutes totaling about 4000 scientists, engineers, and support staffs:

- (1) Institute of Modern Physics (more than 1000 employees)
- (2) Institute of Chemistry and Physics (more than 1000)
- (3) Institute of Glaciology and Cryopedology (350)
- (4) Institute of Geological Sciences (300)
- (5) Institute of Desert Research (280)
- (6) Institute of Plateau Atmospheric Physics (150)

Another research institute located in Lanzhou is the Northwest Institute of the China Academy of Railway Sciences. Both the Institute of Glaciology and Cryopedology and the Northwest Institute are described in some detail later in this report.

* Geotimes, Jan. 1981, and Glaciological Data Report GD-10, World Data Center for Glaciology, Boulder, Colorado



Figure 2. View of Liujiaxia hydroelectric power dam.

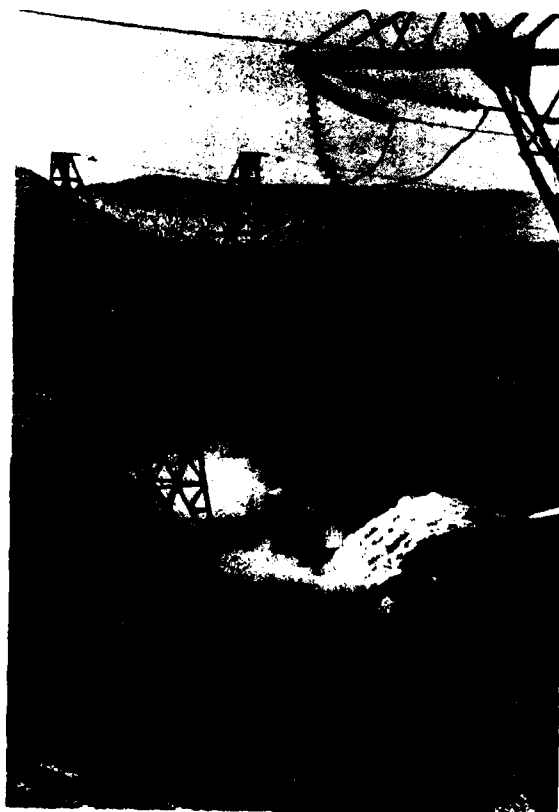


Figure 3. View looking downstream on the Yellow River and the discharge from the Liujiaxia Dam.

CONFERENCE ORGANIZATIONS

Apparently the conference was held under the auspices of the Geographical Society of China and the China Civil Engineering Society although neither society had a visible role. The former society is housed in the Academia Sinica's Institute of Geography on the outskirts of Peking but is apparently under the China Association for Science and Technology.

Table 1 contains the names and organizations of the Organizing Committee for the conference. Information in this table and all subsequent information concerning names of individuals and organizations were compiled from several translated sources and individual conversations. Therefore, there are likely to be errors throughout in spelling of names and accuracy of institutional affiliations.

The two main organizers of the conference were the Institute of Glaciology and Cryopedology and the Northwest Institute of the China Academy of Railway Sciences, both situated in Lanzhou. From the membership of the Organizing Committee it is obvious that the Institute of Glaciology and Cryopedology had the major role in organizing the conference, very likely under the direction of Mrs. Zhou Youwu, Vice-Director. Professor Shi Yafeng, Director of the Institute and Vice Director of the Lanzhou Bureau of the Academia Sinica, opened and closed the conference (Fig. 4).



Figure 4. Professor Shi Yafeng opening the Conference.

Table 1. Organizing Committee for the Second National Chinese Conference on Permafrost

Chairman: Shi Yafeng, Director, Lanzhou Institute of Glaciology and Cryopedology

Vice-Chairman: Wang Zhugui, Vice Director, Northwest Institute, China Academy of Railway Sciences

Zhou Youwu, Vice-Director, Lanzhou Institute of Glaciology and Cryopedology

Xu Shaoxin, Vice-Director, Heilongjiang Provisional Water Conservancy Scientific Research Institute

Secretary: Wang Zijung, Head, Division of Science and Technology, Lanzhou Institute of Glaciology and Cryopedology

Committee Members:

Ding Dewen, Permafrost Division, Lanzhou Institute of Glaciology and Cryopedology

Wang Lian - Northeast Institute of Survey and Design, Ministry of Electricity

Liu Hongxu - Heilongjiang Provincial Low Temperature Construction Science Research Institute

He Xin - Editor, Lanzhou Institute of Glaciology and Cryopedology

Guo Hanbing - Vice-Director, First Highway Survey and Design Institute, Ministry of Communications.

He Changgeng, Third Institute of Survey and Design, Ministry of Railway

Tong Boliang, Permafrost Division, Lanzhou Institute of Glaciology and Cryopedology

Lu Guowei - Yakeski Institute of Forestry, Survey and Design Ministry of Forestry

Ding Qingkong - Northwest Institute, China Academy of Railway Sciences, Ministry of Railway

Ji Lianwu - Northwest Institute, China Academy of Railway Sciences, Ministry of Railway

Wu Ziwan, Vice-Head, Permafrost Division, Lanzhou Institute of Glaciology and Cryopedology

Chen Xiaobai, Permafrost Division, Lanzhou Institute of Glaciology and Cryopedology

Xu Shuyin - Department of Geology and Geography, Lanzhou University

Huang Xiaomin - Vice Director, Northwest Institute, China Academy of Railway Sciences, Ministry of Railway

Cheng Guodong - Vice Head, Permafrost Division, Lanzhou Institute of Glaciology and Cryopedology

Wang Zhugui, Vice-Director of the Northwest Institute, China Academy of Railway Sciences, played a major role in the conference, particularly with the foreign delegates. A large number of representatives attended from Northeast China; the spokesman of that group was apparently Xu Shaoxin. There is a Society of Glaciology and Cryopedology housed in the Institute of Glaciology and Cryopedology that totals over 450 members from throughout China. Yafeng, Zhugui and Shaoxin are officers of the Society. A Northeast China section was organized at the conference. Foreigners can join for 2 yuans (about \$1.25) and receive the quarterly journal at no charge.

CONFERENCE FORMAT AND PRESENTATIONS

Table 2 is the revised conference program. The first two days of the conference were devoted to plenary sessions. State-of-the-art presentations were given by senior representatives. Each of the three foreign delegates was asked to give a 1- to 2-hour presentation. During the Chinese presentations a simultaneous translation capability in English was available through a tape recording system and ear plugs. Qiu Guoqing, a permafrost specialist, translated Brown's presentation into Chinese after a quick dry run to sort out terminology problems. Dr. Yen spoke in Chinese throughout, which greatly facilitated communications.

Two and one-half days of concurrent paper sessions followed the plenary sessions. There were three concurrent sessions. Although a program was available in advance in both Chinese and English, the sequence and actual titles of papers changed. Brown attended Session I and Yen attended Session II. Appendix A is the contents of the published abstract volume. Appendix B is a list of the papers actually presented.

There were a total of 185 abstracts and titles. Approximately 90 papers were actually presented. The abstracts are divided into four categories. The groundwater papers were not presented in Session I, and the Session IV papers on exploration and measuring techniques were in different sessions. Many of the field observations and papers were centered along the Qinghai-Xizang highway which has provided access to many permafrost features and problems. The permafrost of Northeast China was a focus for additional papers.

The titles of the 185 abstracts (App. A) are the best indicator of the scope of the meeting. Table 3 is a subdivision of the papers by specific topics as listed in the preface to the abstract volume. A total of 169

Table 2. Revised Program

The Second National Chinese Conference on Permafrost
12-17 October 1981, Lanzhou, China

11 October - Arrivals

12 October 1981

Morning: Chairman - Zhou Youwu, Vice Director, Lanzhou Institute of
Glaciology and Cryopedology

Opening Speech - Professor Shi Yafeng, Director, Lanzhou Institute of
Glaciology and Cryopedology

Dr. Kuroiwa, Japan

Snow, ice, and frozen ground studies in Japan

Tong Boliang, General Cryopedology Section, Lanzhou Institute
of Glaciology and Cryopedology

Regional study of permafrost in China

Afternoon: Chairman - Xu Shaoxin, Vice Director, Heilongjiang Provincial
Research Institute of Water Conservancy Science

Wang Zhugui, Northwest Institute, China Academy of Railway
Sciences, Lanzhou,

Railroad construction and scientific research in permafrost in
China

Dr. Yin-Chao Yen - U.S. Army Cold Regions Research and Engineer-
ing Laboratory, Hanover, N.H.

CRREL's structure, mission, and its major research and
engineering activities

Wu Ziwan, Vice Head, Permafrost Division, Lanzhou Institute of
Glaciology and Cryopedology

Study on mechanics of permafrost in China.

Evening - Banquet (see list of participants, Appendix C).

13 October 1981 - Morning: Chairman - Professor Shi Yafeng

Lu Zhaojin, Professor, Chinese Academy of Railway Sciences

Mechanisms of soil deformation and problems in soil mechanics

Xu Shaoxin (paper read for him)

Cryopedology and its study and practice in hydraulic
engineering in China

Ding Dewen, Lanzhou Institute of Glaciology and Cryopedology,

Thermologic study of frozen ground in China

Wang Zhengqin - Harbin Architectural and Civil Engineering
Institute

Frozen soil construction engineering - a review

Table 2 (cont'd).

Afternoon

Dr. Jerry Brown - U.S. Army Cold Regions Research and Engineering Laboratory

Permafrost investigations in northern Alaska (Qiu Guoqing - interpreter)

Guo Hanbing - First Highway Survey and Design Institute, Ministry of Communications

Construction and maintenance of the blacktopped Tibet highway
Visit to Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica, Professor Shi Yafeng and staff (for foreign delegates only)

Evening: Banquet at Professor Shi's residence for foreign delegates.

Music Show: Gansu Provincial Youth Group for all conference participants at the hotel.

14 October - Concurrent Sessions (see individual lists of papers actually presented and list of abstracts - Appendices A and B)

Session I. Distribution, characteristics and formation of frozen ground

Session II. Basic physico-mechanical properties and processes in frozen ground

Session III. Engineering design and construction in permafrost

Luncheon at Mr. and Mrs. Tong Boliang's residence for foreign delegates

Dinner at Mr. and Mrs. Zhu Yuanlin's residence for Y.-C. Yen and J. Brown

Movie at hotel - Glaciers in China

15 October - Continue concurrent sessions

16 October

Morning - Complete concurrent sessions

Afternoon - Discussion Groups

Session I. General Cryopedology: Orientation and task of cryopedology in China.

Chairman: Zhou Youwu

Secretary: Cheng Guodong and Guo Dongxin

Session II. Physical, mechanical, and thermal characteristics and process in freezing ground: Orientation and task of cryopedology in China

Chairman: Wu Ziwang

Secretary: Ding Qingkong and Zhang Changqing

Table 2 (cont'd).

Session III. Engineering Cryopedology: Orientation and task of
cryopedology in China
Chairman: Huang Xiaomin
Secretary: Chen Xiaobai and Yang Hairong
Visit to the Northwest Institute by Brown and Yen, followed by a banquet at
the Institute

Evening Session: J. Brown briefed representatives of all organizations on
Fourth International Conference on Permafrost and the
Third International Symposium on Ground Freezing.

17 October - Trip to Liujiaxia Hydroelectric Power Station for visitors
Group discussions continued in Lanzhou

18 October, A.M. - Visits to White Pagoda Mountain and Fire-Spring Mountain
P.M. - Summary and Closing Ceremony
Chairman: Wang Zhugui

Summaries:

Session I - Zhou Youwu
Session II - Wu Ziwang
Session III - Huang Xiaomin
Instructions to the authors - Yuan Yuan Rong
Comments by Y.C. Yen
Comments by J. Brown (see App. G)
Comments by Xin Wenying on railway needs
Comments by Kung Guinguan on northwest China problems
Closing Address - Professor Shi Yafeng

19 October - Visit to Lanzhou Institute of Glaciology and Cryopedology for
detailed discussions and presentations.
J. Brown - Organization and conduct of permafrost research in the
United States
Y.C. Yen - Selected cold regions topics including the author's
own research

20 October - Departure

papers were received by the organizers. Each of the two Lanzhou institutes
presented more papers than any other organization represented.

The authors generally used overhead projectors with handwritten
acetates or glass plates. Several authors presented well-illustrated 35-mm
slide talks. A modified poster session approach was used by many authors
during their presentations. Several English-speaking scientists and inter-
pretors assisted Brown during individual presentations. This type of

Table 3. Number of papers and titles in each category
(based on abstract volume).

- I. Distribution, Characteristics, and Formation of Frozen Ground (55)
 - 1. Regional permafrost studies (19)
 - 2. Historical aspects of permafrost (3)
 - 3. Groundwater in permafrost regions (6)
 - 4. Regional factors and permafrost (3)
 - 5. Cold action and underground ice (14)
 - 6. Frozen ground region environment and ecology (3)
 - 7. Upper and lower boundaries of frozen ground and methods of determination (7)
 - II. Basic Physico-mechanical Properties and Processes in Frozen Soils (58)
 - 1. Methods of measurement and calculations of physical, thermal, acoustic and dielectric properties of frozen ground (8)
 - 2. Theories on migration of moisture and heat in frozen ground (8)
 - 3. Frost-heave action in the processes of soil freezing (29)
 - 4. Frozen ground strength, deformation and flow (13)
 - III. Engineering Designs, Construction and Damage Prevention in Frozen Ground (61)
 - 1. Road construction engineering (10)
 - 2. Bridge and tunnel engineering (6)
 - 3. Water supply and discharge engineering (6)
 - 4. Foundation and buildings (23)
 - 5. Water conservation (11)
 - 6. Integrated problems (5)
 - IV. Exploration and Measuring Techniques in Frozen Ground (11)
 - 1. Application of geophysical methods in frozen ground (2)
 - 2. Application of remote sensing in frozen ground (2)
 - 3. Measuring and testing methods (6)
 - 4. Instrumentation (1)
-

assistance, plus a partial set of English abstracts, helped the foreign delegates in following most of the technical presentations. Preprints of most Chinese papers were available but unedited. A number of draft papers from Sessions I and II were obtained and are available at CRREL.

A series of discussions and business meetings followed the 4-1/2 days of sessions. Results of these discussions were presented at the closing session. Zhou Youwu in her summary remarks appealed for more cooperation among organizations and less duplication, problems which seem to be creating some difficulties. The inconsistencies in terminology, classification

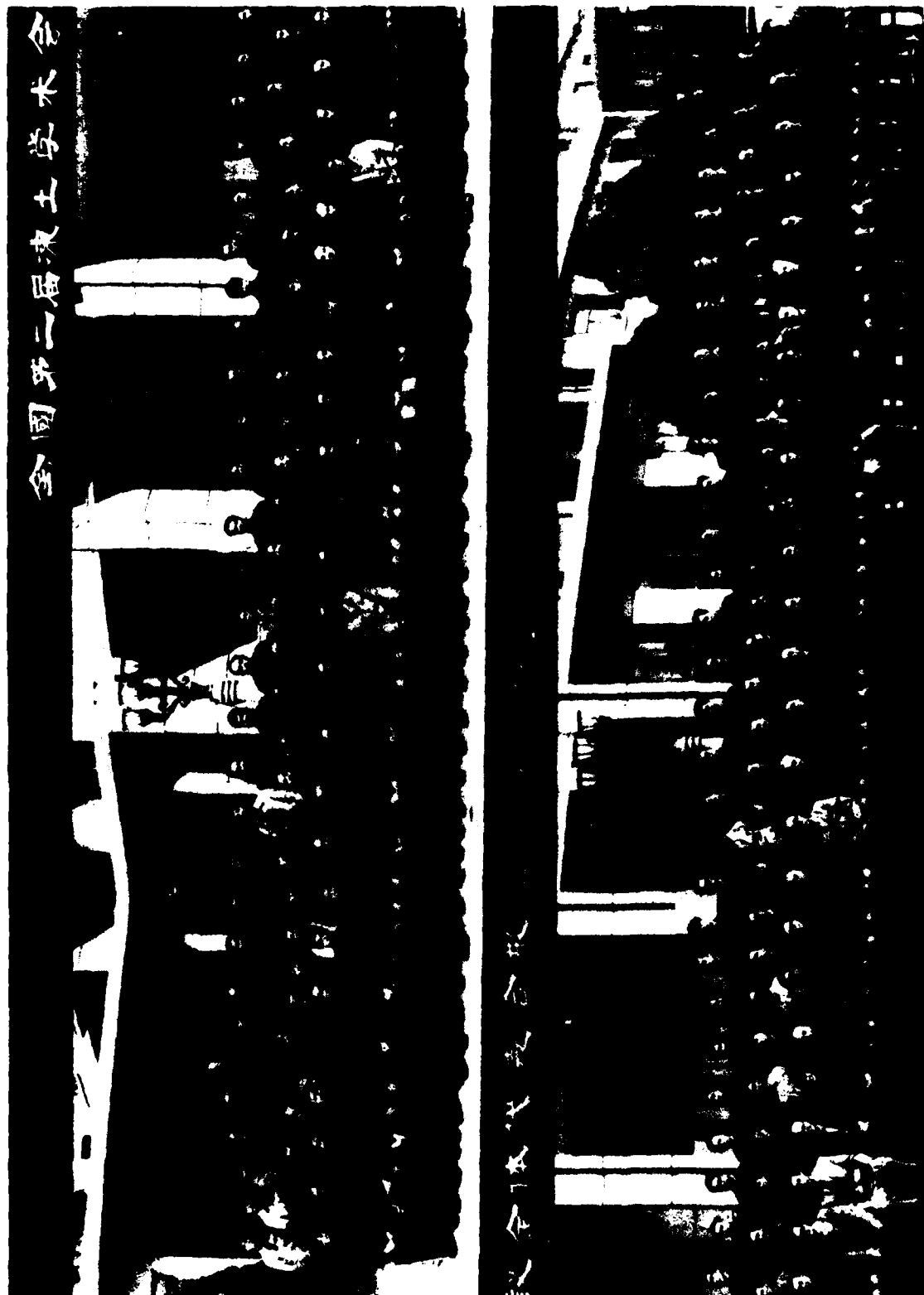


Figure 5. Photograph of the Conference participants.

and methodologies were also indicated as problems. To overcome this, Professor Shi announced that a meeting would be held in Northeast China next year to discuss testing and methods. A second meeting will be held in October 1982 to discuss questions of Quaternary glaciers and periglacial phenomena. It is our understanding that Professor Cui Zhijui of Peking University is organizing that conference in Huang Shan (10-17 October 1982).

By invitation, Brown briefed leaders of the major institutions on the Fourth International Conference on Permafrost (Fairbanks, July 1983) and the Third International Symposium on Ground Freezing (CRREL, June 1982). Professor Shi had translated the Permafrost Conference Bulletin No. 1 into Chinese and all delegates received a copy. Brown described the paper and panel sessions, the field trips, and general logistics. The Chinese estimated that \$3000 would be required for each delegate. This will be a major problem and could limit attendance, although the Chinese are still estimating 20 to 30 participants. As a result of the conference, a method was set up to select representatives to the Fairbanks conference. All technical representatives are expected to speak English. A selection board was established. Papers presented at the Lanzhou conference were to be submitted by 31 December 1981. A voting scheme will be used for selection. Mr. Li, of the Railway Academy, suggested that Professor Shi chair the selection committee. During the plenary session, an editor provided details on how to prepare the manuscripts according to accepted international standards.

Both Yen and Brown spent considerable time discussing the Ground Freezing Symposium to be held at CRREL in June 1982. Many Chinese would like to attend and asked that their abstracts be considered even though the deadline has passed. Upon return to CRREL, the Symposium organizers provisionally accepted upwards of 10 abstracts that were discussed in China.

PARTICIPANTS IN THE CONFERENCE

A total list of participants was not available to us by the close of the conference. Figure 5 is the official photograph of the conference participants. A good cross section of attendees can be obtained from the program (Table 2), the Organizing Committee (Table 1), the banquet attendees (Appendix C) and the list of participants and contributors in Appendix D. In addition, the abstract volumes (English and Chinese) contained the

Table 4. List of Institutes Contributing Papers.

Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica
 Changchun Institute of Geography, Academia Sinica
 Northwest Institute, China Academy of Railway Science
 First Institute of Survey and Design, Ministry of Railway
 Third Institute of Survey and Design, Ministry of Railway
 Research Institute of Qiqihar Railway Bureau
 Northeast Institute of Survey and Design, Ministry of Electricity
 First Institute of Survey and Design, Ministry of Communication
 Research Institute of Water Conservancy Science, Heilongjiang Province
 Research Institute of Water Conservancy Science, Jilin Province
 Research Institute of Water Conservancy Science, Liaoning Province
 Northwest Research Institute, Ministry of Water Conservancy
 Water Conservancy Institute of Survey and Design, Heilongjiang Province
 Water Conservancy School, Heilongjiang Province
 Research Institute of Water Conservancy Science
 Water Conservancy Bureau, Gansu Province
 Low Temperature Construction Research Institute, Heilongjiang Province
 Fourth Construction Ltd., Heilongjiang Province
 Survey Institute of Construction, Qinghai Province
 Institute of Hydrogeology and Engineering-Geology
 Institute of Geology, Jilin Province
 First Geological Team, Qinghai Province
 Institute of Coal Mining, Anhui Province
 Harbin Architectural and Civil Engineering Institute
 Northeast College of Agriculture
 Department of Geography
 Yakeshi Survey and Design Institute of Forestry
 Fenglin Forestry Bureau, Yichun City
 Department of Geology and Geography, Nanjing University
 00926 Unit

affiliations of the participants. A list of organizations is presented in Table 4 based on papers presented. We were told that 69 organizations were represented. About 20 of them are located in northeast China, i.e. Heilongjiang, Jilin and Liaoning Provinces. The major research institutes are the Third Institute of Survey and Design, Ministry of Railway; the Low Temperature Construction Research Institute, Heilongjiang Province; and the

Water Conservancy Institute of Survey and Design, and they submitted 20, 10 and 11 papers respectively. The Lanzhou Institute of Glaciology and Cryopedology definitely occupies a very important role in permafrost research in China. This institute alone prepared 65 papers (about 1/3 of the total papers submitted for the conference). The Northwest Institute, which also performs basic and applied permafrost research and is under the supervision of the China Academy of Railway Sciences, contributed 17 papers to this conference. Three of the papers were prepared by the Chinese Revolutionary Army (stationed in northwest China, based on the material contained in the abstract). It is interesting to note that in China research and site investigations are also conducted in the Army. On the basis of the number of papers presented, the main institutes are:

The Institute of Glaciology and Cryopedology

Third Institute of Survey and Design, Ministry of Railway

The Northwest Institute, China Academy of Railway Sciences

Low Temperature Construction Research Institute, Heilongjiang
Province

Water Conservancy Institute of Survey and Design

VISITS TO THE LANZHOU INSTITUTES

During and following the conference, the foreign delegates were taken to the two hosting Lanzhou institutes and were briefed on the history, current organization and programs, shown the library and laboratory facilities, and had opportunities to discuss activities with individuals. The following contains some detail of these visits.

Institute of Glaciology and Cryopedology (12-19 October 1981)

We had two sessions at the Institute of Glaciology and Cryopedology. The late afternoon visit on 13 October was a general briefing and tour (Fig. 6). An all-day session on 19 October involved briefings by Yen and Brown, informal discussions and a visit to the library. The general history and organization of the institute, contained in Appendix E, is the same report that was available to Dr. Péwé in June 1980.

The Institute totals about 350 people of which 240 are research professionals. The personnel include one professor (senior researcher); 10 associate professors (associate researchers); one senior engineer, 52 assistant researchers, and 33 engineers. The Institute is housed in a 4- to 6-story building which is located in one of a series of buildings



Figure 6. Photograph at front entrance to the Institute of Glaciology and Cryopedology. From left to right: Qiu Guoqing, Zhu Yuanlin, Wu Zuwang, Xu Shaoxin (Harbin), Tong Boliang, Cheng Guodong, Zhou Youwu.

directly across the thoroughfare from Lanzhou University. The Desert Institute shares the building with the Institute of Glaciology and Cryopedology. The Permafrost Division, with its labs located behind the main building, has over 60 staff and support members. Academia Sinica apartment buildings for the staffs of the various institutes are located behind and adjacent to the institutes.

Table 5 is an abbreviated organization chart for the Institute of Glaciology and Cryopedology and is based on various sources available at the conference.

On our first visit to the institute, the director, Professor Shi Yafeng welcomed us in the conference room, introduced us to key staff, and provided copies of an atlas of China and several beautifully illustrated books on glaciers and mountains of China. We then visited the exhibit room which consists of a series of photographic wall displays on each division and its activities. Heads of each division described the work which included glaciers, debris flows, and instrumentation. The vice director, Wang Wenying, who has already visited the U.S. and CRREL, showed us the institute's mapping capability which includes stereo and ortho-photo plotters (Topocart brand) and a large camera for map reproduction. The

Table 5. Partial Organization and Staff of the Lanzhou Institute of Glaciology and Cryopedology, Academia Sinica (compiled by J. Brown).

Director, Professor Shi Yafeng

Vice Directors (total of four)

Zhou Youwu - Associate Professor, Permafrost

Wang Wenying - Senior Engineer, Mapping

Wang Zhunai - Assistant, Research

Glaciology Division (Staff of 51 with seven sections and one field station)

Xie Zechu, Head, Associate Professor

Permafrost (Cryopedology) Division (staff of 65 with six sections)

Wu Ziwang - Vice Director, Associate Professor

Cheng Guodong - Vice Director, Assistant Professor

General Cryopedology Section

Tong Boliang - Associate Professor

Guo Dongxin - Assistant Professor

Qiu Guoqing - Assistant Professor

Frozen Ground Mechanics Section

Cheng Xiaobai - Associate Professor

Zhu Yuanlin - Assistant Professor

Zhang Changqing - Assistant Professor

Thermophysics Section

Ding Dewen - Associate Professor

Xu Xiaozu - Assistant Professor

Zhu Linnan - Assistant Professor

Geophysical Section

Huang Yizhi - Assistant Professor

Division of Glacial and Debris-Flow Sedimentology (staff of 24)

Survey and Mapping Service (staff of 20)

Analysis Laboratories of Material Composition, Wu Xiao-ling (staff of 15 with three sections)

Research Laboratories of Remote Sensing and Telemetry (staff of 27 with three sections)

Zeng Ounzhu - Head

Cha Meisheng

Luo Xianrui

Liang Fengxian

Library and Information Service (staff of 15 with three sections)

Editorial Board (staff of 11)

Interpreter-Gao Jenen

chemistry labs under Wu Xiao-ling's supervision include a clean room, gas and ion chromatographs, a hydrogen enrichment system and liquid scintillation for carbon-14 analyses.

The Permafrost Division has a coldroom complex containing six coldrooms, one of which contains individual insulated cabinets. Tests on frost heave, road-bed models, and creep deformation were ongoing. A 200-point data logger is available to monitor the coldroom tests. Xu Xiaozu described the thermophysics labs. There were three different instruments for thermal conductivity measurements. Instruments for measuring unfrozen water, diffusivity on unfrozen and frozen samples, and specific heat were also observed. A constant temperature room (+20°C) is used for calorimetric measurements. The mechanics lab has uniaxial and triaxial testing machines, a Japanese consolidation apparatus, and frost heave field testing equipment.

Brown met several times with the remote-sensing group. It is currently mapping terrain, glaciers and snowline with Landsat color products provided by the USGS for the glacier inventory. We discussed a cooperative effort using digital data analysis similar to our current work in northern Alaska with the USGS-Ames group. We tentatively agreed on areas in northwest and northeast China for preliminary evaluation. The group has also used satellite imagery (NOAA) to evaluate snowmelt and runoff.

The Institute library is extremely impressive. In addition to the Chinese periodicals it has a wide variety of journals in English and other languages. The total number of journals exceeds 250. The institute promised us a list of its periodicals. A two-floor stack contains bound journals and books. Total accessions exceed 23,000. A reprint file is also maintained. Brown went over the Chinese indexing system for natural sciences and reviewed the card catalogue system. While in Peking the Institute of Geography provided Brown with its current non-Chinese bibliographic publication. It is our distinct impression that we do not have a comprehensive bibliography of Chinese permafrost and glaciological literature in the U.S., although the IGY Data Center in Boulder, Colorado, has initiated a bibliographic effort in these fields. We indicated to Professor Shi Yafeng that development of bibliographies should be an element in our joint U.S.-Chinese exchanges. The Institute of Glaciology and Cryopedology is an excellent starting point for such a compilation. There are six staff members in the library. We have since received a bound bibliography of frozen ground research covering the period 1938 to 1979.

Visit to Northwest Institute, China Academy of
Railway Sciences - 16 October 1981

Drs. Yen and Brown were warmly welcomed by Li Jia, Director of the Northwest Institute, key staff members and Li Yusen, Vice Director, Academy of Railway Sciences (Fig. 7). Li Yusen led the Chinese delegation to Canada in 1975 and to the 1978 Third International Permafrost Conference in Edmonton. We were evidently the first foreigners to visit the institute and it was a special occasion for everyone. We were welcomed by Li Jia in English and then briefed by him in Chinese. The institute is just 20 years old, having been established in 1961, the same year CRREL was established in Hanover, N.H. The Northwest Institute specializes in geologic engineering investigations for the Ministry of Railways and probably conducts studies for other transportation ministries such as Communications (which includes roads). There are 380 staff of which 160 are technical. The institute occupies a number of buildings and we toured through several, observing mainly the laboratories and library.

The Northwest Institute covers a wide range of geographic regions. The desert work includes problems of blowing sand, which buries railway tracks and requires techniques for removal. The plateau conditions at



Figure 7. Welcoming group in front of Northwest Institute.
Front row from right to left: Wang Zhugui, Li Yusen,
J. Brown, Y.-C. Yen, Li Jia.

5000 m ASL include snow and permafrost problems, including the study of thermokarst. The loess problem involves stability and strength.

The institute is divided into the five technical divisions: 1) Landslides, 2) Permafrost, 3) General Research Laboratory, 4) Central Test Laboratory and 5) Library and Technical Information. The institute's major research topics are 1) prevention of landslides, 2) prevention of sand hazards to railways, 3) railway construction in loess regions, 4) railway construction and maintenance in permafrost regions, 5) construction of roads in salt lake regions, and 6) geophysical exploration and civil engineering surveying techniques.

More than 1000 landslide sites along the railroad have been investigated. Studies of landslide mechanics, residual strength and antislides piles were conducted. A great number of studies were conducted concerning the development of technology for building railroads in permafrost regions. The subjects of these studies included foundation engineering on thick underground ice, application of insulation material on frozen soils, development of engineering designs for buildings, bridge sites and foundations, examination of the physics, thermophysics and mechanics of frozen ground, determination of the natural and artificial limits in building bridges and houses, and prevention of frost heaving by chemical means.

In respect to the work on sand control for railway lines, studies on the mechanism of sand transport, solidification of sand mass by chemicals, and mechanical and general sand prevention methods were conducted. As for railway construction in loess regions, slope stability of the road base and the bearing strength of the loess foundation have been studied. Studies for construction of railroads in the salt lake regions, using shallow earthquake instrumentation to determine the upper limit of permafrost and employing electrical methods to explore the resources of underground water, were also undertaken. In civil engineering surveying and measuring techniques, studies are being conducted on the variation of the soil water content of foundations, automatic recording of the ground temperature, and laser holography to determine soil displacement under a concentrated or uniform load.

The Central Laboratory is divided into four sections, i.e. physics, mechanics, chemical analysis and mineral analysis. In the physics laboratory, determination of various physical property indices, such as the grain size distribution, volumetric weight, specific gravity, water content and

plasticity of soils, are made. This laboratory is equipped with various kinds of specific gravity meters, electrical furnaces, vacuum pumps, etc. The mechanics laboratory determines the shear strength, compressive strength, and the coefficient of compressibility of soils using triaxial, vertical-shear, solidification and universal test machines. In the chemical analysis laboratory, tests for determining salt content, water quality, and the amount of volatile components in soils have been conducted with various kinds of precision analytical balances, chemical analysis instruments, and flame photometers. The mineral analysis laboratory determines the principal mineral and chemical element contents with the use of a differential heat calorimeter, an X-ray, a spectrometer and a new Varian model 475 atomic absorption spectrophotometer. We asked for and were given several kilograms of loess on which the CRREL labs will conduct unfrozen water content and thermal measurements for comparison with the institute data.

Most of the instruments are Chinese-made, and though some are quite old and others are very recently manufactured, they all seem to be in good working order. The experiment that impressed us most was the use of a laser to determine the strength field of the soil affected by an imbedded pile. The landslide testing setup included a ring-type shear test apparatus which is Chinese-made and is used to predict conditions of landslides and soil residual strengths. The pile stability test apparatus involves a 3-day duration and measures deflection along the pile shaft, moment around the pile and the pressure strength. This institute has pioneered research on slope stabilization employing 10- to 20-m-long reinforced concrete piles.

The Northwest Institute has just completed a 3-story coldroom facility this year. The basement contains the refrigeration system: there are five compressors with Freon-2 as the working medium. After it is compressed, Freon-2 is cooled through a heat exchanger and becomes a low temperature and pressure liquid, which is subsequently passed through boxes containing CaCl_2 solution. During this process, liquid F-2 absorbs heat from the CaCl_2 solution, and once again becomes gas and is recycled to the compressor. The cooled CaCl_2 solution is pumped to the air-chiller in the coldrooms and also recycled. The temperature in the coldrooms can be lowered to -50°C . The first floor of the facility houses four coldrooms of identical size (6 x 9 m) and is surrounded by an insulated outer corridor. There

is an overhead hoist to the coldrooms which is capable of moving large carts of prepared samples and large-scale model tests. All the wires from the test samples lead out of the coldrooms to a central data collection room on the third floor. The third floor also contains the control room equipped with a large instrument display panel for remote control of operations and monitoring the coldroom complex; the coldrooms can be maintained at $\pm 0.5^{\circ}\text{C}$.

After the tour and discussions, a special banquet attended by about 24 of the senior staff and administration was held in the conference room. All food was prepared in the institute by the staff. It was a particularly friendly and warm reception. Unfortunately we did not obtain a list of the people present or of the staff. However, we were given a number of books and unpublished papers which contain names of those involved in the research. A partial list of subjects is presented at the end of this section and a complete list will be available as soon as the material is cataloged.

Our overall impression of the Northwest Institute is that it is well-equipped, has some excellent geotechnical people who are highly motivated, and it conducts both basic and applied investigations. Although there were many "preprints" of papers, apparently the Chinese system has not, until recently, encouraged journal and other publications. Therefore, a great deal of information is contained in institute files and apparently is not easily accessible. We were given specific permission to take this unpublished information out of the country, in addition to several comprehensive design books. The following is a partial subject listing of the unpublished information:

1. Prevention of landslides
2. Collected works on landslides
3. Road design and construction over deep ground ice
4. Determination of the railroad embankment critical height in the permafrost region of Qinghai-Xizang plateau
5. Calculations of depth of thaw for tunnel foundations in permafrost
6. Determination of the upper limit of an empirical formula for the tunnel foundations in the permafrost region of Qinghai-Xizang plateau
7. Design of various types of foundations of roadway structures in permafrost
8. Basic studies in using explosives for pile foundations in permafrost regions of Qinghai-Xizang plateau

9. Testing of anchors (in plate form) in frozen soil
10. Long-term study of the withdrawal resistance of anchor rods in permafrost
11. Geological problems of road construction in permafrost regions of Qinghai-Xizang plateau
12. Large-scale vertical-cutting field tests in thawed and thawed-frozen soil interfaces
13. Field testing of tangential heave forces
14. Studies of horizontal heave force
15. Development of methods for determining the permafrost table and its application in road building engineering
16. Methods for calculating permafrost tables
17. Variations of the artificial permafrost table of road embankments in the permafrost region of Qinghai-Xizang plateau
18. Bearing capacity of concrete piles in permafrost
19. Permafrost tables after the construction of bridge foundations in the permafrost regions of Qinghai-Xizang plateau
20. Determination of an empirical formula for calculating the thickness of an insulating layer for road construction in the permafrost region of Qinghai-Xizang plateau.
21. Minimizing tangential heave-force with physical and chemical methods.

CONCLUDING REMARKS

No attempt has been made in this report to analyze the technical aspects of the Conference. However, a few general comments are appropriate in a way of conclusions.

It is apparent the Chinese have been and ~~are~~ continuing to be involved in research on both the basic and applied aspects of frozen ground throughout their country. A surprising number of individual organizations are involved. Major practical problems of design, construction and maintenance are obvious from the titles of the papers and the available publications. The Chinese tradition of architecture and construction brings considerable technical experience to frozen ground research. The Ministry of Railway and its Academy of Railway Sciences with over 6000 technical people are obvious leaders in construction of road embankments, tunnels, bridges, and housing on frozen soils. The Institute of Glaciology and Cryopedology is providing the national leadership for permafrost research. The U.S. has no centralized counterparts, except that individuals and subelements within CRREL and USGS provide some focus nationally.

There are some very capable scientists and engineers actively pursuing frozen ground research in China. Many of these representatives will be among the delegates to the Fourth International Conference on Permafrost to be held in Fairbanks in July 1983.

Both the directors of the Ministry of Railway and Institute of Glaciology and Cryopedology indicated their desire to see permafrost research included in the U.S.-Chinese Science and Technology Agreement. We indicated that we would pursue this, if not for 1982, then certainly for the 1983 exchanges. The following is a partial list of topics and activities which can serve as a basis for continuing exchange.

POTENTIAL TOPICS OF US-CHINA COOPERATIVE FROZEN GROUND RESEARCH

Comparison of Laboratory Methods and Results for Frozen Materials

- (1) Thermal properties
- (2) Unfrozen water contents
- (3) Frost heave testing and criteria

Field oriented investigations

- (1) Case histories
 - (a) drainage and icings along roads and railways
 - (b) subsidence of roadbeds and embankments
 - (c) failures of structures due to deep frost penetration
 - (d) stabilization of ground (tunnels, slopes, shafts)
- (2) Properties and distribution of frozen ground
 - (a) massive ground ice occurrence and origin
 - (b) geophysical techniques for detection
 - (c) chemical and physical properties
- (3) Field evaluation of frost heaving
- (4) Remote sensing
 - (a) snow distribution and water yield over frozen terrain
 - (b) indicators of frozen ground
 - (c) glacier sedimentation

Information Exchange

- (1) Update literature - CRREL, USGS, Library of Congress, IGY Data Center A
- (2) Establish routine literature exchanges
- (3) Prepare joint publications and conduct conferences
- (4) Exchange personnel

APPENDIX A. Titles of abstracts in published abstract volume.

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Zhu Qiang, Approach to calculation of frost heaving.

Wang Zhengqiu, Preliminary discussion on the frost-heaving behaviors of fine-grained sand and their classifications.

Gu Zhongwei, Preliminary study on dielectric property of frozen soils.

Ding Dwen, Calculation of frost depth and moisture state in an open system.

Zhu Linnan, Prediction of moisture in the seasonally thawed layer in a permafrost region on the plateau.

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Liu Jinren, Influence of moisture in frozen soil on the velocity of ultrasonic waves.

Tao Zhaoxiang, Thermal conductivity of both the thawed and frozen soils with high moisture.

Fu Rong, Effect of moisture in frozen soils on the ultrasonic velocity.

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Sui Xianzhi, Research on data of tangential frost-heaving forces of cohesive soils for engineering design.

Cui Chenghan, Study on various laws of tangential frost-heaving forces.

Tong Changjiang, Research on normal frost-heaving forces.

Xu Zhenhai, Relationship between allowable frost-heaving deformation and frost-heaving forces, and theoretical calculation of normal frost-heaving forces under different areas of foundations.

Guan Fengnian, Experimental research of horizontal frost-heaving forces on a hydraulic retaining wall.

Chen Xiaobai, Effect of frost penetration rate and overload on frost-heaving.

Yu Chongyun, On the tangential frost-heaving forces.

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Ding Qingkang, Research on horizontal frost-heaving forces.

Tong Zhiguan, Experimental research on large-scale direct shear test for the frozen-thawed boundary and thawed soils in the field.

Ma Shimin, Experimental research on creep behavior of frozen soils under uniaxial compression tests and failure behavior of frozen soils.

Wu Ziwang, Discussion on problems of rheological behavior in frozen soils.

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Xie Yingqi, Research on frost-thaw properties of cohesive soils under saturated and consolidated state.

Liu Hongxu, Research on mechanical problems of frozen soils by the theory of calculation of layered half space.

Wu Ziwang, Residual strength of frozen soils.

Zhu Yuanlin, Elastic and compressive deformation of frozen soils.

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Huang Xiaoming, Design and construction of cutting in massive ground-ice area.

Bing Wenshan, Design theory and calculation in frost-resistant layer on concrete surface.

First Survey and Design Institute of Highway, Ministry of Communications:
Application of lime-stabilized soil on the highway engineering in alpine permafrost regions.

Liu Yongzhi, On the height of embankments with asphaltic pavement in permafrost regions on Qinghai-Xizang highway.

Ling Chuanwei, Design and practice for preventing frost-heave in sleeper beam bridges with shallow foundations.

Wang Ziyuan, Ministry and Railway: Studies on adaptability and principles of building foundations in permafrost regions on the Qinghai-Xizang Plateau.

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Ye Bayou, Discussion of calculation methods on the thawing ground depth of culvert foundations in permafrost regions.

He Jie, Experimental research on the method of laying water supply and drainage pipes in permafrost regions.

Zhang Jianqiu, Design of water-supply and drainage engineering in permafrost region on the Qinchai-Xizang Plateau.

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Zhao Yunlong, Discussion of computation on the thawing depth for foundation of heating in permafrost region.

He Changgeng, Thawing plate of a heated building.

Li Chenlong, Determination of depth of building foundations according to classification of frost heaving types.

Chen Zhuohuai, Types of railway construction foundations in permafrost region and their evaluation.

Chou Wanxi, Discussion of some questions on the earth stress in the frozen wall of a deep shaft.

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Ding Qingkang, Long-term pull resistance of anchorage rod in permafrost.

Zhang Luxin, Experimental research on the anchorage plate in frozen ground.

Ding Dewen, Numerical study of the freezing process of the shaft wall.

Xu Shaoxin, Prevention and remedy for damage of hydraulic structures in seasonally frozen soils.

Sun Yuliang, Deformation and stability of irrigation ditch under the action of frost-thawing.

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Kong Quinuan, Classification of frost susceptible soils under irrigation canals lined with plain concrete and antiheaving measures.

Ling Chuanwei, Preventive measure of frost damages in drainage systems in seasonally frozen ground regions.

Guan Fengnian, Some new types of hydraulic structures adaptable in cold regions.

Wang Liang, Thawing and freezing properties of soil and construction of earth dam in winter.

Li Anguo, Calculation of the normal frost-heaving forces on lined plates of a ditch.

APPENDIX C

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*Numbers refer to pages in abstract volume. (See App. A.)

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Appendix E

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Zhou Youwu (Associate Professor)

This Institute was developed primarily on the basis of an Alpine Ice and Snow Utilization Team organized by Academia Sinica in 1958. Its first task was the investigation of mountain glaciers of Northwestern China. In 1960 the research work of permafrost was added. In 1962, the organization was changed into the Division of Glaciology and Cryopedology, Institute of Geography, Academia Sinica. It investigated mountain glaciers in West China, the permafrost of the Qinghai-Xizang (Tibet) Plateau, and hydrology of arid regions in Northwestern China. In 1964, the study of debris flow was also started. In 1965, the Division of Glaciology and Cryopedology amalgamated with the Division of Desert Research from Peking, forming the Institute of Glaciology, Cryopedology and Desert Research, Academia Sinica, and carrying on scientific studies on glaciers, frozen ground, desert and debris flow. In June 1978, the Division of Desert Research was changed into an independent institute, with the remainder forming the Institute of Glaciology and Cryopedology. This Institute includes: 1) Division of Glaciology; 2) Division of Cryopedology; 3) Division of Glacial- and Debris-flow Sedimentology; 4) Surveying and Mapping Service; 5) Analysis Laboratories of Material Composition; 6) Research Laboratories of Remote Sensing and Telemetry; 7) Library and Information Service; 8) Editorial Board. At present there are 350 staff and workers.

The important research areas are as follows:

Glaciology: This Division mainly studies the distribution, physical properties, variation and natural resources of ice and snow in China and

* Edited from the original English copy

the action of Quaternary glaciation. Since 1958, the important regions investigated are the glaciers of Qilian Shan, Tian Shan, Mt. Qomolangma and Mt. Xixiabangma of the Himalayas and other alpine regions of Qinghai-Xizang (Tibet) Plateau; control of avalanche and snow drifting in Tian Shan; and the mechanics of ice jamming on the Yellow River. Since 1974, the research has included the variation of glaciers in the Karakoram, repairing the damaged section of China-Pakistan Highway in the Qilian Shan, and the effective utilization of water resources for the promotion of agriculture in the Kansu Corridor. New achievements have been made on the forecasting of advances and recessions of glaciers. In recent years, with the help of aerial photos and large-scale topographic maps, and in accordance with the specified requirements of the World Glacier Inventory Program, nearly 3,000 glaciers in Qilian Shan have been properly inventoried. New progress has been achieved in the fields of glacial hydrology, the relations between glaciers and climate, glacial sedimentation, Quaternary glaciation and climatic variations.

Permafrost: We mainly investigate the formation, development and the prevention of damage to permafrost along the Qinghai-Xizang Highway, in several coal mining districts of Qilian Shan and also in some places in Northeast China. In recent years, we conducted research on the distribution and thermal properties and mechanics of permafrost along the Qinghai-Xizang Highway and obtained a group of fundamental parameters on mechanics and other data as required for railway design. The investigation of frozen ground through the Tian Shan for the Southern Xin Jiang Railway has also been taken up. Frozen soil mechanics (including frozen soil rheology, frost heave forces, frozen strength and thaw settlement), frozen soil heat capacity (frozen soil thermal heat conductivity, water migration, changes in temperature field, etc.), ground ice, seasonal frozen soil and other fields have also been studied. Recently, a map of the permafrost distribution along the Qinghai-Xizang Highway at a scale of 1:500,000 has been compiled, based on the characteristics of permafrost on the Qinghai-Xizang Plateau.

Debris Flow: We mainly study glacial debris flow and the characteristics, distribution, formation, development and preventive measures of debris flow. In recent years, we investigated the debris flow along the

Sichuan-Xizang Highway and in Dongchuan district of Northwest provinces. Preventive projects have been engineering works of various plants, mines, factories and Scientific data are useful for socialist construction.

Surveying and mapping: We are mainly involved in aerial stereophotogrammetry of glaciers, permafrost etc. We have finished the 1:500,000 maps of the Peak area, and the 1:60,000 maps of the Batura glacier region, and the 1:200,000 maps of Tomol Peak in Tian Shan and also several other districts.

Material analysis: Mainly the materials in cold regions and trace elements in snow and ice. We have quantitative analytical data to the study of glaciology.

Remote sensing and telemetry: In recent years, a thermometer has been fabricated and put into use. It is being used, and satellite images and aerial photos are used in the analysis of changes in glaciers, snow and permafrost, the amount of snow and ice resources, and the forecast of snow melt, supplying new means for the study and development of glaciology and cryopedology.

Library and information: In our library, there are 1000 books and more than 240 journals, Chinese, English, Russian, etc. All of the above-mentioned publications are related to the disciplines with which we are concerned. In addition reports, papers, journals and books are acquired from 20 nations on a exchange basis and from 200 institutes/organizations in China. Most recently we have begun to publish a quarterly with English titles, abstracts, and foreign information entitled "Journal of Glaciology and Cryopedology."

Editorial Board: The final product of scientific investigations by the staff in and out of our institute takes the usual form of publications. Among others, the quarterly "Journal of Glaciology and Cryopedology" (in Chinese and with English abstracts) has been published by the Editorial Board since 1979.

permafrost

permafrost

... attending the
... National
... committee on
... permafrost
... as an advisor
... to the
... agencies.

permafrost -

... leaving - chaired
... Buffalo.

... and cooperation

... have become available. My
... permafrost, and vegetation
... studies of hydrology, remote
... would like to discuss some of
... contained in several reports, which
... maps of Alaska. Please do not
... during the conference.

*Presentation was taped and has been translated into Chinese (Chinese copy
available at (RREL)).

Appendix G. Comments by J. Brown at the Closing Ceremony - Second
National Chinese Conference on Permafrost - Lanzhou
18 October 1981

I would like to, once again, express my appreciation to the Organizing Committee for this opportunity to participate in the Conference. In the last six days I have learned a great deal about Chinese permafrost and frozen ground research, and the related engineering problems. It is my observation that there are more organizations, researchers and engineers in China than in the U.S. and perhaps Canada combined. The quality of the research in China is very good. You also have developed extensive practical experience.

In the U.S. we are interested in many of the same frozen ground problems: 1) distribution of permafrost, 2) frost heave and properties of soil and water, 3) geophysics, 4) remote sensing and mapping, 5) construction.

In the last ten years in the U.S. there have been many studies associated with pipelines and roads. Our experience only goes back to the 1940's. So our research is not very old either.

During 1981, there was another permafrost conference. In March 1981, the Canadians held a conference that was similar to the one held here in Lanzhou this week. The publication of the Canadian proceedings will be of great interest to you. It will contain reports on recent research in North America. The proceedings will be dedicated to Dr. Roger Brown who died last year. I will ask the Canadians to send copies of this book to you when it is published.

Now for some comments about this conference. The Organizing Committee is to be congratulated for the excellent preparation for the conference. The conference was very well organized. I personally appreciated the English abstracts and translations. Many of the presentations were well illustrated with 35-mm slides, lantern slides and photographs. This is the procedure we use in the U.S. These visual aids help the audience to understand the presentations. Many papers were available for distribution at the conference. This is also very good as it gives the participants an opportunity to study the reports. Following the presentations, there were

some good discussions between the authors and the audience. This is also very useful.

The summary papers on the first two days provided excellent reviews of past research. These survey papers will be important contributions to the international permafrost research. I hope the papers will contain literature references to the major published research. I look forward to receiving all of these papers.

I attended Session I. I learned a great deal about permafrost distribution, characteristics, and formation. I now appreciate the full extent of permafrost in China. You have many excellent detailed observations which are being published. The formation of ground ice, the degradation of permafrost, the age of permafrost and periglacial features and thermal conditions of the ground are all of great interest to me and my colleagues. The comparison of these characteristics with those in North America, Europe and Asia is very important.

It is my impression that the papers presented in Sessions II and III were also very significant. The engineering aspects of permafrost and frozen soil are very important in solving practical problems. We have the same problems of designing, building, and maintaining roads and structures on seasonally frozen ground and permafrost. Frost heave and permafrost degradation are our major problems. You have many case histories or practical experiences with frozen soils. The reports from Session III will be of great value to us.

In summary, both the quantity and quality of the work and papers are impressive. I will take back many ideas to report to my colleagues in North America. You have many excellent papers for the 1983 Conference in Alaska. I wish the Conference organizers success in editing and publishing the results of the conference. I will always remember this conference for the scientific exchanges and for your friendship.

I look forward to seeing some of you at CRREL in 1982 and in Alaska in 1983. I also look forward to returning to China to see your frozen ground under actual field conditions. Perhaps an international conference will be possible.

Thank you once again.